June 23, 2010

To: David Shaw, Co-Chair, PCAST NITRD Review Working Group
Ed Lazowska, Co-Chair, PCAST NITRD Review Working Group

From: George Strawn, NITRD Subcommittee Co-Chair
Jeannette Wing, NITRD Subcommittee Co-Chair

Re: NITRD **r**esponse to request for information to support PCAST NITRD Review

The attached document provides the NITRD response to the request of the President's Council of Advisors on Science and Technology (PCAST) for information about progress toward and impediments to achieving the recommendations of the 2007 PCAST report entitled *Leadership Under Challenge: Information Technology R&D in a Competitive World.* The NITRD response includes:

1. A rating of the NITRD community's perception of achievement of each recommendation

2. A short summary of progress and impediments regarding each recommendation

3. Responses to questions of specific interest to the Review Working Group

If you need additional information about NITRD or any of the activities cited in our response, please let us know and we will reply promptly.

On behalf of the NITRD agencies, we would like to express our appreciation for your time and consideration.

Sincerely,

Jeannette Wing, NITRD Subcommittee Co-Chair

George Strawn, NITRD Subcommittee Co-Chair

NITRD Responses to PCAST Report

Leadership Under Challenge: Information Technology R&D in a Competitive World

Recommendations

Recommendation 1 (2.1[1] – page 23)

To provide a solid basis for subsequent action, the NITRD Subcommittee should charge the NITRD National Coordination Office to commission one or more fast-track studies on the current state of and future requirements for networking and information technology undergraduate and graduate education.

Response
Rating – 5 – achieved and met desired outcome

As authorized by the NITRD Subcommittee, the National Coordination Office (NCO) commissioned SRI International to address:

- The expected supply of and demand for NIT professionals over the coming decade, with a focus on women and other underrepresented groups
- Comparisons with other nations

SRI carried out these tasks by reviewing the existing educational and workforce data and literature and also by interviewing experts on their analysis of NIT workforce issues facing the United States and its likely global competitors over the next decade. The study was completed May 2009. An electronic copy of this report is available at: http://www.nitrd.gov/About/NIT_Workforce_Final_Report_5_29_09.pdf. To pursue the findings of this report an education team is being formed under the Social, Economic and Workforce Implication of IT and IT Workforce Development (SEW) Coordination Group.

Recommendation 2 (2.2 – page 23)

To help meet national needs for personnel with advanced degrees in networking and information technology fields, the Federal government should:

- Increase the number of multiyear fellowships for graduate study by American citizens in NIT fields each year, with the target number and fields of such fellowships informed by needs identified in sources such as the NIT education study
- Streamline the process for obtaining visas for non-U.S. students admitted to accredited graduate degree programs in NIT subjects
- Make it routine for foreign nationals who have obtained advanced degrees in NIT subjects at accredited U.S. universities to be permitted to work and gain citizenship in the United States by easing the visa and Green Card processes for them

[1] Numbers in parentheses reference the chapter and recommendation number in the August 2007 PCAST Report, *Leadership Under Challenge: Information Technology R&D in a Competitive World.*

- Simplify the visa process for international NIT R&D experts who visit the United States on a regular or a frequent basis for professional purposes

Response
Rating – 3 – partially achieved and on track

Response to Bullet 1 - New funding available through the America Recovery and Reinvestment Act (ARRA) of 2009 created new opportunities in fellowships in NIT through the National Science Foundation (NSF), National Institutes of Health (NIH), National Institute of Standards and Technology (NIST) and Department of Energy/Office of Science (DOE/SC). NSF's support for graduate research fellowships in computing continued to increase in FY10 and in its request for FY11, representing a doubling in two years.

Response to Bullets 2-4 – Although streamlining and simplifying the visa process is under the purview of policy advisors at the Department of Labor, Department of Homeland Security (DHS) (U.S. Citizenship and Immigration Services), and lawmakers, the NCO will do its best to keep NITRD abreast of these activities. As of spring 2010, bills concerning work visas (e.g., H-1B and L-1) are pending in both the House and Senate; their focus appears to be on reforming "abuses" in the visa program and ensuring that employers seek to hire U.S. citizens before turning to foreign workers. A separate, recently introduced Senate bill would make it easier for immigrant entrepreneurs to establish startup companies if they hire U.S. workers.

Recommendation 3 (3.1 – page 26)

Federal agencies should rebalance their networking and information technology R&D funding portfolios by increasing: (1) support for important networking and information technology problems that require larger-scale, longer-term, multidisciplinary R&D and using existing or new mechanisms to address those problems and (2) emphasis on innovative and therefore higher-risk but potentially higher-payoff explorations.

Response
Rating – 5 – achieved and met desired outcome

Federal agencies have made significant advancements toward funding larger-scale, longer-term, multidisciplinary R&D to emphasize innovative, higher-risk and potentially higher-payoff explorations. For example, DARPA has three new efforts explicitly intended to solicit innovative ideas with high potential payoffs: the Clean-Slate Design of Resilient, Adaptive, Secure Hosts (CRASH) program to pursue the design of new computer systems that are highly resistant to cyber-attack, can adapt after a successful attack in order to continue rendering useful services, learn from previous attacks how to guard against and cope with future attacks, and can repair themselves after attacks have succeeded; the Safer Warfighter Communications (SAFER) program to develop technology that will enable safe, resilient communications over the Internet, particularly in situations in which a third-party is attempting to discover the identity or location of the end users, or block the communication; and the Ubiquitous High-Performance Computing (UHPC) program seeking new science and technologies for radically new computer systems that overcome energy efficiency, dependability, and programmability challenges. The NASA Nebula project is exploring the cloud computing model for Federal scientific research activities. NIH is requesting applications for specialized centers in the area of biomedical computing as requested by the Biomedical Information Science and Technology Initiative report in 1999. The anticipated award is September of 2010. NSF has created a foundation-wide flagship multi-disciplinary

Cyber-enabled Discovery and Innovation (computational thinking for science and engineering) program, launching the Computer and Information Science and Engineering (CISE) Expeditions Program and funding the Future Internet Architectures Program. Another example of a funding opportunity that requires support for important larger-scale, longer-term, multidisciplinary R&D in networking and information technology is the DOE/SC project entitled, "Scientific Data Management and Analysis at Extreme Scale," which encourages interdisciplinary partnerships among academic institutions, national laboratories, and industry.
http://www.science.doe.gov/grants/FOA-10-0000256.html

NSF allocated ARRA funding in networking and IT research and experimental research infrastructure Global Environment for Network Innovations (GENI); DOE/SC allocated ARRA funds to a 100 Gbps network that requires development of new technologies and has the potential to significantly advance networking capabilities and an effort to improve our ability to understand the multicore revolution in computing.

Recommendation 4 (3.2 – page 27)

The Director of the Office of Science and Technology Policy should call on senior officials from Federal agencies with large academic networking and information technology R&D budgets to meet with senior officials from the Nation's major research universities to address how better to conduct large-scale, long-term, multidisciplinary academic research in the development and application of networking and information technology important to the Nation.

Response
Rating – 3 – partially achieved and on track

The NITRD Program regularly solicits technical inputs and perspectives from academia and organizations representing academic researchers, as well as from industry and the public. For example, the Program publicly solicited their views on the future of NIT and the Federal role in NIT R&D and held a two-day non-government forum and webcast, with many invited speakers from academia, to gather ideas about what should be included in the NITRD strategic plan.

The NITRD agencies each year sponsor and/or fund workshops bringing together academic researchers to discuss the most difficult research challenges in their fields. The participants' workshop reports typically are commented upon by the agencies and published by the NCO as "national research needs" documents. Such documents – for example, *High-Confidence Medical Devices: Cyber-Physical Systems for 21st Century Health Care* and *Report of the Interagency Optical Network Testbeds Workshop 2* – play an important role in shaping the national research agenda in critical technologies. The agencies also invite academic experts to serve on review panels.

Many NITRD-supported R&D activities directly engage university-based researchers and organizations. For example, the NITRD advanced-networking agencies have collaborated with Internet 2, which coordinates networking for colleges and universities, in developing an infrastructure called perfSONAR that makes it possible, for the first time, to automatically measure the performance of optical networks across multiple domains. As a result of NITRD efforts, the perfSONAR infrastructure is being adopted by science networks, commercial network managers, and international science networks through cooperative development and deployment.

To encourage bold thinking in computing and communications research: (1) NSF/CISE convened a "Computing Outside the Box" meeting with participation by the deans and department heads of the top 40 schools/departments of computer and information science and engineering; and (2) NSF is running a session at the 2010 Computer Research Association (CRA) Snowbird meeting (for all deans and department heads) on "Thinking Big: Competing Successfully for Big Research Funding."

Recommendation 5 (3.3 – page29)

The NITRD agencies should use, to the fullest extent practicable, available authorities and resources to facilitate the transfer of research results into practical application and commercial products.

Response
Rating – 3 – partially achieved and on track

NITRD agencies have significantly increased their programs to rapidly transition R&D results into government operations and the commercial sector. Several NITRD agencies participate in Small Business Innovation Research (SBIR) programs including DOE, NSF and DHS Science and Technology (DHS S&T).

DOE issues solicitations inviting small businesses to apply for R&D grants as part of their SBIR and Small Business Technology Transfer (STTR) programs. Small businesses that win awards through these programs are encouraged to commercialize the technology and also retain the rights to any technology that they develop.

NSF is involved in an interagency collaboration, namely the i6 Challenge, a $12 million innovation competition administered by the Economic Development Administration (EDA) in partnership with NSF and NIH. The i6 Challenge will award up to $1 million to each of six winning teams with the most innovative ideas to drive technology commercialization and entrepreneurship. NSF also participates in the Industry/University Cooperative Research Centers (I/UCRCs) program to help industry develop a longer-term view of its needs, with appropriate attention to research quality.

NIST works directly with industry in supporting testbeds for new technologies and in developing standards in new technology areas. The direct involvement of industry in these efforts fosters rapid and direct transition of new technology into commercial capabilities.

DHS S&T directly supports cyber security technology transfer activities. For instance, the agency's Cyber Security Research and Development Broad Agency Announcement (BAA) consist of a three-phased approach to fund pioneering R&D projects in support of the nation's security and to transfer these innovative advances to the operational environment. The program has been responsible for the production of more than 20 commercially available or open source security products. DHS S&T also supports the Security Innovation Network (SINET) program, a partnership created to increase collaboration between the U.S. public and private sectors. SINET conducts ongoing events such as the annual IT Security Entrepreneurs' Forum and quarterly Information Security Technology Transition Council Meetings that ultimately result in the successful transfer of R&D into commercial products.

Recommendation 6 (4.1 – page 33)

The NITRD Subcommittee should develop and implement a Federal Plan for coordinated multi-agency R&D in high-confidence NIT systems connected with the physical world to maximize the effectiveness of Federal investments and help ensure future U.S. competitiveness in these technologies.

Response
Rating – 3 – partially achieved and on track

Agencies collaborate regularly on cyber-physical systems (CPS) research through the NITRD High Confidence Software and Systems (HCSS) PCA monthly meetings, including yearly planning meetings, and multiagency and multidisciplinary events such as the workshops listed below. There are seven (7) agencies participating in the HCSS PCA with increased funding.

The HCSS Coordinating Group (CG) held an interagency workshop on CPS to brief government agencies on U.S. S&T capacity and the potential of CPS advancement for competitiveness and innovation. The workshop developed a framework for multiagency collaboration to further CPS R&D. Additionally, HCSS prepared the *High-Confidence Medical Devices: Cyber-Physical Systems for 21st Century Health Care* report in February 2009 that identified fundamental scientific and technical challenges posed by the rapidly expanding digital environment in medicine and health care and identified critical research advances needed to enable these innovative new capabilities.

NSF started a CPS program in FY09, receiving over five times the number of expected submissions, and used ARRA funds to supplement the original FY09 allotment. NSF awarded Vanderbilt University a grant (0931632) to establish a virtual organization to support the development and growth of a new CPS multidisciplinary, multisector research community. During 2008-2010, CPS-related workshops were held on topics such as energy, transportation, and security. Three interagency workshops are planned on extreme manufacturing, education, and automotive CPS.

DOE and DHS/S&T jointly support and manage the Trustworthy Cyber Infrastructure for the Power Grid (TCIPG), a 5-year R&D effort beginning 2010 to provide resilience in the nation's electric grid cyber infrastructure, so that the grid can continue to deliver electricity and maintain critical operations even in the presence of cyber attacks.

Recommendation 7 (4.2 – page 35)

The NITRD Subcommittee should facilitate efforts by leaders from academia, industry, and government to identify the critical issues in software design and development and help guide NITRD planning on software R&D.

Response
Rating – 3 – partially achieved and on track

The Software Design and Productivity (SDP) CG formed a partnership with the Association for Computing Machinery (ACM) and is co-sponsoring a November 2010 working conference on the Future of Software Engineering Research. This will provide the international research community an opportunity to envision, discuss, refine, and disseminate new ideas about the future of software design and development. The theme is "Imagining the Future of Software

Engineering Research" (e.g., visions, perspectives, challenges, opportunities, obstacles, issues, and new formulations). This event will bring together academic and industrial visionaries, researchers, NITRD agencies, and other government research funding agencies to discuss future design of more usable, dependable, cost-effective, and sustainable software-intensive systems. The results of the workshop will provide focus for software design and development research and will help guide R&D planning for the SDP CG.

In FY10, NSF announced a Software Infrastructure for Sustained Innovation program to create institutes addressing software for scientific and engineering applications in order to share software systems developed across different disciplines. DARPA's new CRASH, SAFER, and UHPC programs all solict revolutionary innovations in systems, middleware, and application-level software architectures for increasingly demanding DoD applications. The new NSF-funded petascale computing system, Blue Waters, at the University of Illinois – expected to be the world's most powerful supercomputer when it goes online in 2011 – instantiates a new operating system architecture and programming environment testing innovative approaches for efficient multicore throughput. DOE plans to move to exascale to enable scientific discovery at the highest levels of computation and data volume by scaling and integrating core DOE systems as much as possible, while providing industry-standard user interfaces to those core systems. This strategy is intended to maximize the capability of the core as well as its accessibility to scientists.

Recommendation 8 (4.3 – page 37)

The Interagency Working Group on Digital Data, in cooperation with the NITRD Subcommittee, should develop a national strategy and develop and implement an associated plan to assure the long-term preservation, stewardship, and widespread availability of data important to science and technology.

Response
Rating – 3 – partially achieved and on track

The January 2009 report *Harnessing the Power of Digital Data for Science and Society*, prepared by the Interagency Working Group on Digital Data (IWGDD) for the Committee on Science of the National Science and Technology Council, creates a framework for U.S. Government agency data management and data policy plans and provides a strategy to promote preservation and access to the Federal government's digital scientific data. The report represents the combined collaborative effort of representatives from 22 Federal agencies working together in the IWGDD; seven (7) of the participating agencies and representatives are members of the NITRD Program. It describes how "data creation, collection, documentation, analysis, preservation, and dissemination can be appropriately, reliably, and readily managed, thereby enhancing the return on the Nation's R&D investments by ensuring that digital data realize their full potential as catalysts for progress in our global information society." NSF's DataNet program exemplifies and is in line with the goals of this report.

NSF has contributed to the widespread availability of data by partnering with industry to provide a three-cloud infrastructure (Google, IBM, HP, Intel, Yahoo!, and Microsoft) to enable scientists and engineers to perform large-scale, data-intensive computing. DOE has established the Earth Systems Grid to make global climate data widely available and has partnered with NSF to develop the worldwide Open Science Grid, which provides access to data from basic science facilities around the world.

In addition, experts on digital preservation gathered at a workshop at NIST in March 2010 to develop a standards roadmap on preserving the vast and growing amount of digital data over the long term (http://ddp.nist.gov/workshop/home.php).

Recommendation 9 (4.4 – page 38)

A key element of the Federal Plan for Advanced Networking Research and Development should be an R&D agenda for upgrading the Internet. To meet Federal agency needs and support the Nation's critical infrastructures, the Plan should include R&D in mobile networking technologies and ways to increase network security and reliability.

Response
Rating – 3 – partially achieved and on track

Research for the advancement of networking is a critical issue addressed by Federal agencies through NITRD collaboration to provide secure, reliable, multi-protocol networking for the future. LSN agencies are involved in several multiagency activities for FY10, including participation in NSF's Global Environment for Network Innovations (GENI) program to build a virtual laboratory at the frontiers of network science and engineering exploring future internets at scale. LSN is supporting the development of perfSONAR, an infrastructure for network performance monitoring that makes it easier to solve end-to-end performance problems on paths crossing several networks. It contains a set of services delivering performance measurements in a federated environment. These programs enable researchers and network operators to partner in developing new flexible, scalable services and enable operators to create an isolated testing and deployment environment for new systems. The LSN CG is also planning to hold a workshop in FY 2010 to identify and assess the R&D needed to assure the integration of wireless networks seamlessly and dynamically with other network protocols.

The following NITRD activities also contribute to gains in wireless technologies. DARPA's SAFER program is developing technology for safe, resilient, secure communications over the Internet. The technology will also provide the quality of service (QoS) required to support instant messaging, electronic mail, social networking, streaming video, voice over Internet protocol (VoIP), video conferencing, and other media that promote effective communication. NSF, DOE, NASA and other agencies fund significant research in network security to provide trustworthy networking (e.g., NSF's Future Internet Architectures program). NSF, NIST, and DoD fund research that focuses on integrating wireless technologies into dynamic multi-protocol networks.

DOE has allocated ARRA funds to develop a 100 Gbps/lambda network that has the potential to significantly advance networking capabilities; this project requires the development of new technologies, such as a 100 Gbps NIC card, that will be an important advance for commercial network providers. NSF's Network Science and Engineering (NetSE) Program seeks to develop science and engineering knowledge about networks, with the goal of attaining new scientific understanding about their complexity and informing their future design. The program specifically challenges individuals and teams with differing perspectives and domain expertise to come together to develop this understanding. The NetSE program encourages research on Internet-scale, topologically-aware models for accessing, processing, and aggregating multiple high-volume information flows; and on cognitive capabilities, context-awareness, and architectures that enable the discovery, invocation and composition of globally distributed, rapidly evolving services and information systems.

With ARRA funding, NSF partnered with the National Telecommunications and Information Administration (NTIA) and the Rural Utilities Service (RUS) to kick start national broadband deployment for the underserved and with the FCC on the National Broadband Plan. The FCC report on an R&D agenda for wireless spectrum relied heavily on the final report of the 2009 NSF Workshop on Future Wireless Communications Networks.

Recommendation 10 (4.5 – page 40)

The NITRD Subcommittee should develop, implement, and maintain a strategic plan for Federal investments in HEC R&D, infrastructure, applications, and education and training. Based on the strategic plan, the NITRD Subcommittee should involve experts from academia and industry to develop and maintain a HEC R&D roadmap.

Response
Rating – 2 – partially achieved, but not on track

The following was undertaken by High End Computing (HEC) in collaboration with the National Academies (NA) as a first step towards addressing this recommendation.

At the request of the NCO, the National Research Council (NRC) performed a study to consider the potential impacts of high-end capability computing (HECC) on four illustrative fields of science and engineering: astrophysics, the atmospheric sciences, evolutionary biology, and chemical separations. These four fields were chosen to represent the range of science and engineering research topics that Federal research agencies address and thus provided a broad set of HEC-related issues encompassed by the NITRD Program. *The Potential Impact of High-End Capability Computing on Four Illustrative Fields of Science and Engineering* was published 2008 by the NRC.

This report has served as input for the NITRD Strategic Plan which is currently being written at the request of PCAST. The Plan is an overarching vision that incorporates the mission-related strategic planning of the NITRD agencies. HEC is, by its very nature, highly multidisciplinary and, as it grows in complexity, requires the integration of technical expertise across a variety of disciplinary domains. Upon completion of the NITRD Strategic Plan, the HEC agencies will determine what type of roadmap would be most appropriate for the coordination of Federal HEC research.

Recommendation 11 (4.6 – page 42)

The Federal NIT R&D agencies should give greater emphasis to fundamental, longer-term CSIA R&D and the infrastructure for that R&D.

Response
Rating – 5 – achieved and met desired outcome

First, the NITRD Program's draft strategic plan covers all areas of networking and information technology, including cybersecurity and information assurance. One of the plan's three themes is Trust and Confidence, focusing on the importance of a cybersecure cyberspace. For example, NSF's Trustworthy Computing program emphasizes foundations of trustworthy computing, including the science of security.

Second, NITRD's CSIA IWG and the Senior Steering Group (SSG) for Cybersecurity R&D (in collaboration with the Special Cyber Operations Research and Engineering group (a joint OSTP-Office of the Director of National Intelligence [ODNI] effort), are developing a game-change R&D strategy that responds to the leap-ahead goals of the Comprehensive National Cybersecurity Initiative (CNCI) and the innovation goals of the *President's Cyberspace Policy Review*. The three cybersecurity game-change R&D themes were released for public input in May 2010. (http://www.nitrd.gov/CSThemes.aspx). The game-change R&D strategy is principally focused on the fundamental and long-term R&D necessary for achieving the overall goals of a trustworthy cyberspace.

In addition, the NITRD agencies continue to develop and improve the infrastructure for CSIA R&D, namely: the National Cyber Range project by DARPA, the Experimental Research Testbed (DETER) by DHS, the Protected Repository for the Defense of Infrastructure Against Cyber Threats (PREDICT) by DHS, the National Vulnerability Database by NIST, and the Wisconsin Advanced Internet Laboratory (WAIL) by NSF.

Recommendation 12 (5.1 – page 50)

The Director of the Office of Science and Technology Policy should take steps to ensure broad and vigorous agency involvement in the NITRD Program, given its critical importance to national security and economic competitiveness.

Response
Rating – 3 – partially achieved and on track

NITRD, under the direction of OSTP, did the following to broaden agency participation:

- Formed the Health IT Planning Group with HHS/ONC, VA, and FDA joining NITRD agencies NIST, NIH, and NSF in accordance with ARRA, which establishes a responsibility for a health IT R&D component in the NITRD portfolio. To launch this effort, the planning group compiled and presented to OSTP information regarding Federal agencies' current and planned FY11 and FY12 health IT R&D activities and identified possible FY12 strategic investments in health IT R&D. Next, a formal proposal will be presented to the NITRD Subcommittee outlining the organizational structure (including a Senior Steering Committee [SSC] and a CG) that would serve as the health IT R&D component in the NITRD portfolio. Additionally, a health IT summit, similar to the NCLY cybersecurity summit, will be held in November to discuss the three-tiered strategy prioritizing health IT challenge areas that risk failure in the absence of significant health IT R&D advances.
- Engaged in sustained discussions with DHS officials about formal participation in NITRD; DHS became a NITRD agency member in 2010.
- Pursued discussions resulting in full DoD participation in the NITRD program.
- Created the SSG for Cybersecurity R&D to develop a "Leap-Ahead" plan to accelerate high-risk, high-return research to help maintain the Nation's technological edge in cyberspace.
- Invited the U.S. Nuclear Regulatory Commission (NRC) and the National Transportation Safety Board (NTSB) to become participating NITRD agencies; these agencies are active in HCSS discussions of high-confidence and CPS for critical infrastructures.

Recommendation 13 (5.2 – page 50)

The NITRD Subcommittee should develop, maintain, and implement a cohesive strategic plan for the NITRD Program.

Response
Rating – 3 – partially achieved and on track

A full draft of the NITRD Strategic Plan is under review. The plan calls for advancing U.S. capabilities in three broad areas identified as the essential foundations for sustained leadership in a digital world:

- WeCompute – Expanded human-computer partnerships, including more-capable systems, more powerful digital tools for people, and new forms of collaboration between the two.
- Trust and Confidence – The ability to design and build systems with levels of security, safety, privacy, reliability, predictability, and dependability that "you can bet your life on."
- Cyber Capable – Transformed education and training to ensure that current generations benefit fully from cyber capabilities and to inspire a diverse, prepared, and highly productive next-generation workforce of cyber innovators.

The NITRD plan will provide the vision for the future of NIT R&D in the Federal government, while also illuminating the mission-related strategic planning of the NITRD agencies.

Recommendation 14 (5.3 – page 51)

The NITRD Subcommittee should conduct periodic assessments of the NITRD PCAs, restructuring the NITRD Program when warranted.

Response
Rating – 3 – partially achieved and on track

NITRD has reviewed and modified its PCAs in the past and is presently analyzing the impact on our PCA structure of current and pending legislation as well as current and anticipated technological trends. For example, an education team is being formed under the SEW Coordination Group. Upon acceptance of the NITRD strategic plan, the Subcommittee will take up PCA alignment with the plan.

Recommendation 15 (5.4 – page 51)

The NITRD Interagency Working Groups and Coordinating Groups should develop, maintain, and implement public R&D plans or roadmaps for key technical areas that require long-term interagency coordination and engagement. The plans and roadmaps should be developed under the guidance of the NITRD Subcommittee and be aligned with the NITRD Program's strategic plan.

Response
Rating – 3 – partially achieved and on track

The NITRD Program is working towards R&D plans for long-term interagency engagement in the key technical focus areas listed below and will develop new roadmaps based on the approval of the NITRD Strategic Plan.

- The HCSS CG has been engaged for five years with the private sector to produce a series of national workshops and reports to identify and prioritize the R&D challenges that must be addressed to create next-generation CPS in such vital sectors as critical infrastructure (power, water, etc.), aviation, ground transportation, and health care. The findings from this HCSS effort provide a strong basis for a roadmapping activity based on the new strategic plan.
- The LSN CG, in cooperation with additional agencies, likewise has completed a strategic plan for Federal advanced networking R&D, including a detailed matrix of near-, medium-, and long-term technical challenges that provide a basis for roadmapping.
- The CSIA IWG and SSG for Cybersecurity R&D are currently conducting activities, stemming from the National Cyber Leap Year events of 2009, to solicit research ideas from all sectors that might "change the game" of cybersecurity in favor of defenders.
- DHS S&T published *A Roadmap for Cybersecurity Research* in 2009, describing R&D agendas relating to 11 hard problem areas in cybersecurity, based on input provided by a large team of academic and industry experts.
- NITRD agencies, with OSTP support, are currently coordinating R&D efforts to address the academic community-driven Robotics Roadmap (http://www.us-robotics.us/reports/CCC%20Report.pdf).

Recommendation 16 (5.5 – page 52)

The NITRD Subcommittee, with support from the NITRD NCO, should develop a set of metrics and other indicators of progress for the NITRD Program and use them to assess NITRD Program progress.

Response
Rating – 5 – achieved and met desired outcome

Indicators
- Active participation at monthly CG and IWG meetings and at the NITRD Annual Planning Meetings (APMs)
- Agencies participating in NITRD Subcommittee meetings
- Agency program reviews open to other NITRD agencies' attendance and participation
- Numbers of NITRD conferences, workshops (both collaborative, with multiple NITRD agencies sponsoring, and single-agency, with NITRD agencies participating) attracting near 100 percent attendance
- NITRD agencies' participation on review boards
- Research collaboration, coordination, and seminar talks on focus topics by the NITRD agencies
- Agencies agreeing to cooperate on research topics of joint interest.

Metrics
- Number of NITRD member agencies
- Number of participating agencies
- NITRD funding levels (NITRD Supplement to the President's Budget)
- NCO budget level

The NCO supports interagency coordination of R&D activities via monthly PCA planning meetings. The agencies identify their strategic priorities and focus topics, map them to national

priorities, and describe their programmatic highlights for the coming year. The PCA members evaluate and report progress at monthly meetings.

The NCO/NITRD Dashboard presents a unique opportunity to educate the public regarding the proven impacts of investing in R&D. It is part of OSTP's open government activity and contains the crosscutting NITRD agency budgets for the past 17 years. Enhancements to the data include interactive operation and animation of the data to facilitate assessing NITRD Program progress. Science and Technology for America's Reinvestment (STAR) metrics are also being added to document the outcomes of science investments to the public, including those under ARRA. Further visualization projects being considered include the history and metrics of NITRD crosscutting spending variations by PCA and agency (e.g., cloud computing, mobility R&D, cybersecurity, and health IT).

Recommendation 17 (5.6 – page 53)

Under NITRD Subcommittee guidance, the NITRD NCO should develop and implement a plan for supporting the development, maintenance, and implementation of the NITRD strategic plan and R&D plans.

Response
Rating – 5 – achieved and met desired outcome

The NCO support team was tasked with and completed a five-year strategic plan highlighting key goals and strategies to strengthen the office's support for NITRD. The NCO plan addresses the following elements described by the PCAST:

- Planning and coordination of larger, longer-term, multidisciplinary projects
- Greater interaction with academia, industry, and international entities
- The planning of national workshops and preparation of workshop reports
- Overall improved communications with NITRD and NCO stakeholders

Action plans will be updated on a yearly basis to reflect and support the current NITRD strategy.

Additional questions of specific interest for the PCAST NITRD review:

1. Have NITRD agencies made efforts to explore prospects for providing visas to graduates of U.S. advanced degree programs? See response to 2 – bullets 2-4.
2. What has been the response amongst NITRD agencies to the call for a plan on cyberphysical systems and greater funding in this area? See response to 6.
3. What progress has been made to achieve a data preservation and access plan? See response to 8.
4. What is the status of the NITRD strategic plan and roadmaps? See response to 13 and 15.
5. Since the last PCAST report, has the risk portfolio for research shifted to favor more high risk projects? See response to 3.
6. Did increased funding through ARRA influence the risk/reward balance? See response to 2, 3, 6, 9, 12, and 16.